FARMERS' BULLETIN 1153

UNITED STATES DEPARTMENT OF AGRICULTURE

COWPEAS

UTILIZATION

THE COWPEA PLANT may be fed to live stock as pasturage, hay, or ensilage, and the seed may be used as human food. Cowpeas are not grown for seed more generally because of the uncertainty of the crop, the expense of harvesting, and the low yield commonly obtained. These factors have created a relatively high price for the seed.

In localities well suited to production it will be found highly profitable to grow cowpea seed on a large scale, especially if the best machinery for handling the crop is used.

Harvesting cowpea seed can be done most cheaply by the use of machinery. The crop may be cut with a mower, self-rake reaper, or bean cutter. When the plants are thoroughly dry, the seed may be thrashed with an ordinary grain separator with modifications, or, better still, with a machine specially constructed for thrashing cowpeas.

The seed has a high feeding value, but is rarely cheap enough to use as feed. It is fed to some extent to poultry.

The cowpea is generally and favorably known in the South as a staple human food, being used in the pod, shelled green, and shelled dry.

Good cowpea seed can be stored for a considerable length of time without much danger of loss of vitality.

Cowpea hay is an excellent roughage for all kinds of stock. When cut at the right stage of growth and properly handled, the cowpea is equally as nutritious as the hay from other legumes and is greatly relished by all farm animals.

The hay is somewhat difficult to cure, but with attention to the stage of growth and to weather conditions, little more trouble will be experienced in obtaining well-cured cowpea hay than red-clover or alfalfa hay.

The cowpea alone has not given good results as a silage crop, the best silage being obtained when it is mixed with corn or sorghum.

Although pasturing cowpeas is not considered the best farm practice, under certain conditions it is advisable and quite profitable.

As a soiling crop the cowpea can be advantageously used to supplement crops with less protein, such as corn, sorghum, and millet.

The cowpea has been used more as a soil renovator than any other legume because it is so easily grown, has such a marked effect upon succeeding crops, and succeeds under such a great diversity of conditions.

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief
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COWPEAS: UTILIZATION.

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CONTENTS.

THE PRINCIPAL USES OF THE COWPEA.[1]

THE COWPEA is of ancient cultivation for human food, particularly in Africa and Asia, and also in the Mediterranean region of Europe. Although in the United States it has been grown mainly for soiling, hay, ensilage, and pasturage for all kinds of stock and as a soil-improving crop, nevertheless the seeds, chiefly of the Blackeye and White varieties, have been commonly used for human food in the Southern States.

For feed the cowpea is especially valuable, because it will grow on all types of arable soil, requiring little attention and producing most excellent forage. In addition, it is of great value as a green-manure crop to increase the humus and the nitrogen content of the soils upon which it is grown.

Cowpea hay should be substituted in the Southern States for much of the hay which is now being purchased in the North and West. The greater use of this crop for hay and pasturage increases the production of live stock, an essential factor in securing the maximum returns in any system of agriculture. It also aids much in keeping the soil in good tilth and maintaining its productiveness.

COWPEAS FOR SEED.

On a very large proportion of the area planted to cowpeas, little effort is made to harvest seed. Moreover, cowpeas have not been grown very extensively for seed in late years, thus creating a high

[1] The culture and varieties of this crop have been discussed in another publication. (Morse, W. J., Cowpeas: Culture and varieties. U. S. Dept. Agr., Farmers' Bul. 1148, 1920.)

price which has restricted the use of the crop. The principal factors in making the cowpea an undesirable crop to grow in a commercial way for seed production are the uncertainty of a seed crop, the expense of harvesting, and the low yields generally obtained. However, the value of the crop for forage and soil improvement and the high price of seed make it highly desirable for every farmer to grow sufficient seed to supply at least his own needs. At high prices, most farmers do not feel that they can afford to buy seed for soil-improvement purposes. With a small acreage harvested each year for seed, a supply will always be available for farm use.

The demand for seed of well-known varieties has kept the prices in recent years so high as to make cowpea-seed production a profitable line of farming. Localities well suited to its production will find it highly profitable to grow seed on a large scale, especially if the best machinery for handling the crop is used.

FIG. 1.—A field of the Victor cowpea grown for seed production.

Cowpea seed has a high feeding value, but it is not cheap enough to use for feed. It is a very palatable and nutritious human food and is quite generally used as such throughout the Southern States.

TIME OF HARVESTING.

Cowpeas ripen so unevenly that it is difficult to judge just what is the proper stage of maturity to cut for seed. With nearly all varieties except under certain conditions, as in the cowpea areas of California, blossoms and green and ripe pods occur at the same time, and this condition continues usually until frost.

In harvesting cowpeas for seed the vines should be allowed to mature a greater percentage of pods than when cut for hay. (Fig. 1.) In general, the crop should be harvested when one-half to two-thirds of the pods are matured. Although some loss will occur as a result of overripe pods shattering the seed, more seed will be

obtained than if the crop is harvested before a large percentage of the pods are ripe.

METHODS OF HARVESTING.

Various methods of harvesting the cowpea for seed are employed in different sections of the cowpea region. Hand picking (fig. 2) is the most common way of saving the seed, although the most expensive and laborious, and is the only practical method when the crop is grown in corn. Small fields of cowpeas, grown alone for seed, are often hand picked, especially the edible sorts, as the Blackeye and White varieties. In this way the seed can be gathered as the pods ripen. The pods are gathered at a fixed price per hundred

FIG. 2.—Harvesting cowpeas for seed by the hand-picking method.

pounds, the rate depending on labor conditions, or the picker receives one-third to one-half of the total quantity gathered. When hand picked, the seed yield is much larger, is of a better quality, and a higher price is obtained. The pods are picked by hand into bags and stored. When thoroughly dry, the seeds are either beaten out with flails (fig. 3) or the pods are run through a pod huller. The seed is then cleaned by running it through a fanning mill.

Another method of harvesting by hand is to pull up the vines or to cut with a corn knife or sickle. The vines are placed in small shocks and left in the field until well cured. This method is slow and only practicable where the acreage is small.

When large fields are grown for seed production, various machines are used for cutting the vines. Some difficulty is experienced in

harvesting cowpeas by machinery, due principally to the vining habit of the plant. The mowing machine is very generally used. The chief objection to this is the fact that the machine and horses have to pass over the crop while in the swath, which shatters the seed badly. This may be avoided, however, by attaching a bunching or windrowing attachment to the cutter bar of the mowing machine, which lifts the vines as they are cut and carries them to one side, out of the way of the next round. This method also leaves the plants in a more desirable condition for curing and handling.

The self-rake reaper (fig. 4) has given very satisfactory results, as the vines are placed in bunches of convenient size for handling and curing, out of the way of the machine and team.

FIG. 3.—Flailing out cowpea seed, a method used to some extent in the Southern States.

Several types of bean and pea picking machines are on the market, but are not extensively used. These machines gather the pods from the vines in the fields. The crop must be planted in rows for the most successful application of the pea picker, and the entire plant must be mature and dry before the machine will do satisfactory work.

The bean harvester, of which several types commonly are employed in harvesting field beans, will work well with cowpeas planted in rows. The most successful of these harvesters are constructed so that the long knives run under the vines, cutting off the stems beneath the surface of the ground. In the Blackeye pea districts of California, a bean cutter, consisting of a pair of sharp knives about 3½ feet long and mounted on a sled from which they stand inward and slope backward at an angle of 60°, is the commonest method of harvesting. The sled straddles two rows and the knives are set to run about 2

inches beneath the surface of the soil, cutting the roots where they are soft and leaving the plants in one windrow.

When cut, the vines should be allowed to cure until thoroughly dry. The curing or drying may be done in the swath, cock, stack, or barn as desired, weather conditions largely determining the method to be employed. Although the amount of work required is greater, the hay or straw is of better quality if the curing or drying is done in the stack or barn. The belief is general that weevils will not affect the seed stored in the pods. Experience, however, shows that the damage from the weevil seems to be about as great to the seed in the pod as in the seed thrashed and stored.

FIG. 4.—Harvesting cowpeas for seed with a self-rake reaper.

METHODS OF THRASHING.

The ordinary grain separator can be adjusted to thrash cowpeas successfully and is the machine most generally used. For the best results in thrashing cowpeas the essential point is to maintain a low and even speed of the cylinder, 300 to 400 revolutions per minute, while the speed of the rest of the machine should be maintained as for thrashing wheat or oats. Although satisfactory results are obtained with an ordinary separator, it is generally found that too many of the pods pass through unopened with the straw, the machine is easily choked by the tangled vines wrapping around the cylinder, and the percentage of cracked seed is usually large.

Several modifications of thrashing machines (fig. 5) have been devised for handling cowpeas. Many of these machines have adopted the use of two cylinders. The cylinders are adjusted to run at different speeds, the front one about 300 revolutions and the rear one

about 450 revolutions to the minute. The employment of two cylinders results in a smaller percentage of unopened pods passing through with the straw, but in a somewhat larger percentage of cracked peas.

Another modification applied to machines with either one or two cylinders is the sharpening of the teeth on the concaves or on both the concaves and cylinders. The sharp teeth cut the vines and this prevents them from wrapping around the cylinder. Moreover, the power required is materially reduced and the percentage of cracked seed is decidedly less. The straw is finely chopped, thus being in excellent condition for feeding.

One of the most successful thrashers yet devised is that in which the teeth of both cylinder and concaves are sharpened and there is a minimum of clearance. The concaves are arranged in two sets,

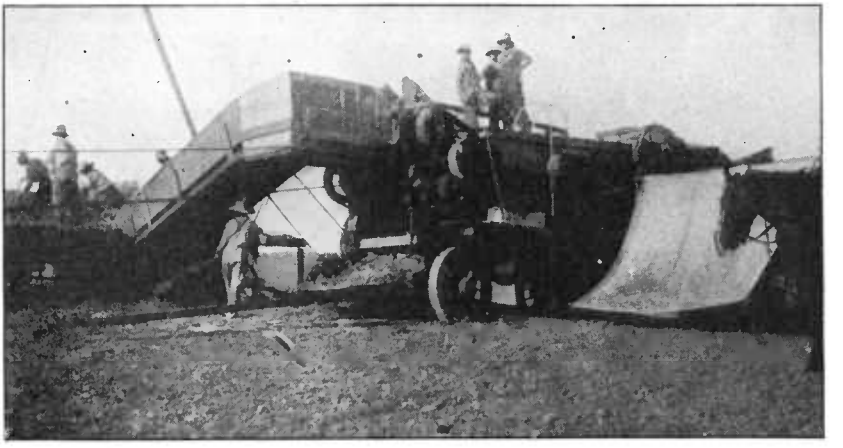

FIG. 5.—Thrashing seed in the Blackeye cowpea region of California.

one of two rows and the other of three. The percentage of cracked seed is very small, the vines are finely chopped, and all of the seeds are released from the pods.

In thrashing cowpeas it is necessary to have sufficient power to give a uniform speed to the separator. It is also essential that the cylinder be kept uniformly full in order to get the best results, as running empty increases the number of cracked seed.

STORAGE OF SEED.

Cowpea seed, if good, can be stored for a considerable length of time without much danger of loss of vitality, as shown in Table I. If the peas are sufficiently cured in the field, mow, or stack before thrashing, there is little danger of heating. However, seed not properly cured or stored quickly loses its vitality; consequently a germination test is always advisable.

Cowpea seed is subject to attack from insects, especially the cowpea weevil. There are usually some weevils in the seed when thrashed and placed in storage, and in a warm temperature they emerge and lay their eggs upon the other stored seed.

In the Southern States, on account of the injury to stored grain, it has been found desirable in many cases to place in cold storage the seed intended for planting. This is not very expensive and has been found to be a practicable way of preserving the seed.

Table I gives the results of germination tests with seeds of different varieties kept for 4, 7, and 10 years in a storeroom.

TABLE I.—*Germination of seed of standard varieties of cowpeas when stored for different periods.*

Variety.	Length of time seed was stored.			Variety.	Length of time seed was stored.		
	4 years.	7 years.	10 years.		4 years.	7 years.	10 years.
Whippoorwill.....per cent..	96	93.5	79.5	Blackeye.....per cent..	22	3.5	0
New Era.....do....	73	61	18	Red Ripper.....do....	3.5	.5	0
Iron.....do....	60.5	17.5	14.5	Groit.....do....	0	0	0
Clay.....do....	38	8	1.5	Michigan Favorite.....do....	0	0	0
Black.....do....	79	82	.....	Extra Early Blackeye...do....	0	0	0
Taylor.....do....	50	26.5	0				

Cowpea seed more than 2 years old ordinarily has lost much of its viability. Good viable seeds are uniformly bright colored, while seeds which have been exposed to moisture or are dead are duller and darker in color.

PROPORTION OF SEED TO HULLS.

In view of the fact that gathering the pods by hand is very generally practiced throughout the South, the proportion of seeds to pods is a matter of importance. The results obtained at different experiment stations indicate that the proportions of seed and hulls vary according to the variety and locality, as shown in Table II.

TABLE II.—*Weight of seed in 100 pounds of pods of standard varieties of cowpeas.*

Variety.	Alabama.	Arkansas.	Arlington Farm, Va.	Variety.	Alabama.	Arkansas.	Arlington Farm, Va.
Whippoorwill.....pounds..	73	67.3	65.2	Red Ripper.....pounds..	71	66	67
New Era.....do....	73	61.8	67.8	Taylor.....do....	77	64.7	72
Groit.....do....	.....	.....	63.1	Large Blackeye.....do....	77	71.2	76.3
Brabham.....do....	.....	.....	69.2	Extra Early Blackeye do....	76	75	72.3
Iron.....do....	69	65.3	66	Black.....do....	76	73.2	71.7
Clay.....do....	67	58.3	63.5	California Blackeye...do....	.....	.....	73.3
Wonderful.....do....	70	.....	.....	Early Buff.....do....	.....	.....	73

FEEDING VALUE OF COWPEAS.

Cowpea seed is rarely obtainable at a price sufficiently low to justify its use as a feed. However, in thrashing, more or less seed may be broken, making it unfit for planting. Such seed ground and mixed with corn meal or other ground grain makes especially good feed for hogs and dairy cows. The composition of cowpea seed, as shown in Table III, indicates that it is of high feeding value in comparison with other feeding stuffs. The Alabama Agricultural Experiment Station[2] used cowpeas for fattening pigs with excellent results. In other feeding trials at the station mentioned cowpeas and corn were found practically equal in feeding value when fed separately, but a mixture of both proved more satisfactory than either alone. The Delaware Agricultural Experiment Station[3] reports that feeding weevil-eaten cowpea seed to 12 calves as a substitute for wheat bran at the same price per ton resulted in a saving of $7.20 per month. Excellent results have been obtained by feeding cowpea seed, either whole or cracked, to poultry.

TABLE III.—*Digestible nutrients of cowpea seed in comparison with those of other feedstuffs.*[a]

Feeding stuff.	Digestible nutrients in 100 pounds.				Feeding stuff.	Digestible nutrients in 100 pounds.			
	Protein.	Carbohydrates.	Fat.	Total.		Protein.	Carbohydrates.	Fat.	Total
Cowpea.....pounds..	19.4	54.5	1.1	76.4	Oats.....pounds..	9.7	52.1	3.8	70.4
Canada pea.....do....	19.0	55.8	.6	76.2	Wheat middlings.do....	15.7	52.8	4.3	78.2
Soy bean.....do....	30.7	22.8	14.4	85.9	Velvet bean.....do....	18.1	50.8	5.3	80.8
Wheat bran.....do....	12.5	41.6	3.0	60.9	Corn.....do....	7.7	66.1	4.6	84.2

[a] Henry, W. A., and Morrison, F. B. Feeds and feeding. Ed. 17, x, 691 p. Madison, Wis., 1917.

COWPEAS FOR HUMAN FOOD.

The cowpea is generally and favorably known as a table food in the Southern States.[4] Its limited use in the dietary of other parts of the United States is due chiefly to the fact that the culture of the cowpea has been confined principally to the South. No great effort has been made to create a general market, and competition with the navy or field beans in the North has not been developed. It is a most wholesome and nutritious foodstuff, from which a great variety of palatable as well as economical dishes can be made.

Cowpeas are used in three forms for human food—in the pod, shelled green, or shelled dried. In these forms they correspond, re-

[2] Duggar, J. F. Peanuts, cowpeas, and sweet potatoes as food for pigs. Ala. Agr. Exp. Sta. Bul. 93, p. 113–134. 1898.

[3] Neale, A. T. The development of a dairy herd. *In* Del. Agr. Exp. Sta., 12th Ann. Rept. [1899] 1900, p. 8–13. 1901.

[4] Langworthy, C. F., and Hunt, Caroline L. Use of corn, kafir, and cowpeas in the home. U. S. Dept. Agr., Farmers' Bul. 559, 12 p. 1913.

spectively, to string beans, shelled green peas, and dried navy beans and call for much the same methods of preparation for the table.

Undoubtedly the cowpea is of the greatest palatability from the time the pods begin to turn yellow until they begin to shrink in ripening. At this stage they are much larger than when fully mature and dry, are more easily cooked, and of better flavor. The color of the seed has much to do with the popularity of the cowpea for table use. The White varieties, such as the Conch, Cream, or Lady, and the Blackeye varieties, such as the California Blackeye and Large Blackeye, are preferred to the colored varieties.

YIELDS OF SEED.

The yield of seed, like that of hay, depends to a very large extent upon conditions of weather, soil, culture, and variety. In many sections the cowpea is rather an uncertain crop, as the yield of seed varies greatly from year to year. The seed yields of the most important commercial varieties reported by investigators at various agricultural experiment stations are shown in Table IV. In general, the figures show the average yields for a number of years and indicate the best seed-producing sorts.

TABLE IV.—*Yields of seed to the acre of the best varieties of cowpeas at different agricultural experiment stations.*

Variety.	Average yield of seed per acre (bushels).														
	Alabama.	Louisiana.	Arizona.	Arkansas.	Delaware.	Georgia.	Indiana.	Kansas.	Mississippi.	Missouri.	North Carolina.	Oklahoma.	South Carolina.	Texas.	Virginia.[1]
Black	21.1	13.0	.....	15.7	7.4	19.9	8.1	11.1	14.2	18.6	12.9	.....	13.0	20.3	20.0
Brabham	.....	.....	.....	.....	.....	11.1	.....	.....	29.1	.....	10.0	.....	.....	4.0	10.6
Clay	10.8	.....	.....	9.8	6.6	34.3	5.3	10.9	14.0	14.4	13.7	.....	13.3	2.1	.....
California Blackeye	.....	.....	.....	.....	.....	5.9	.....	4.1	.....	.....	.....	8.1	16.3	.....	16.3
Early Buff	.....	.....	2.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	12.6	19.7
Extra Early Blackeye	16.4	.....	.....	29.1	5.4	.....	14.2	9.9	.....	.....	9.2	.....	9.9	7.2	18.8
Groit	.....	.....	.....	.....	8.2	.....	.....	.....	26.8	14.8	17.3	2.2	.....	8.3	27.3
Iron	14.9	5.0	.....	.....	7.4	15.8	7.2	2.5	14.8	17.5	8.3	3.3	9.3	14.3	10.9
Large Blackeye	17.0	6.0	.....	23.6	5.6	31.3	.....	12.7	17.1	14.8	21.7	.....	21.7	17.0	26.3
Michigan Favorite	.....	.....	.....	.....	8.2	.....	19.3	11.2	.....	11.4	7.9	.....	.....	.....	19.8
Monetta	.....	.....	6.4	.....	.....	.....	.....	.....	.....	.....	10.9	.....	.....	1.3	13.2
New Era	22.0	18.7	.....	39.9	15.6	6.9	14.0	12.4	22.3	14.0	14.7	5.0	24.2	9.6	25.2
Red Ripper	19.3	4.5	.....	11.9	.....	27.7	.....	7.9	14.2	8.3	14.2	2.0	.....	2.7	.....
Taylor	23.6	.....	.....	19.9	4.9	11.3	.....	11.9	21.7	.....	10.6	2.4	11.5	9.7	18.6
Unknown	14.7	.....	.....	2.5	3.5	30.5	.....	.5	10.0	.....	4.4	1.5	.....	13.4	.....
Whippoorwill	12.4	12.7	.....	25.6	13.2	25.3	18.3	11.5	28.5	14.0	14.8	1.0	13.8	16.5	10.1

[1] Arlington Experiment Farm.

COWPEA STRAW.

The straw obtained from thrashing the cowpea for seed is a valuable feed for all kinds of stock. Although no data from feeding tests with this straw are available, farmers and liverymen who have

used it claim that it is an excellent feed, some even preferring it to cowpea hay. No ill effects have been reported from its use. Table V gives the digestible nutrients of cowpea straw in comparison with those of the straw of other crops commonly used for feeding.

TABLE V.—*Digestible nutrients of cowpea straw compared with those of the straw of other important crops.*[1]

Kind of straw	Digestible nutrients in 100 pounds.				Kind of straw.	Digestible nutrients in 100 pounds.			
	Protein.	Carbohydrates.	Fat.	Total.		Protein.	Carbohydrates.	Fat.	Total.
Cowpea.....pounds..	3.4	39.1	0.7	44.1	Wheat.....pounds..	0.7	35.1	0.5	36.9
Soy bean.....do....	2.8	38.5	1.0	43.5	Rice.....do....	.9	37.8	.3	42.8
Oat.....do....	1.0	42.6	.9	45.6	Barley.....do....	.9	40.2	.6	42.5

[1] Henry, W. A., and Morrison, F. B. Feeds and Feeding. Ed. 17 x, 691 p. Madison, Wis., 1917.

COWPEAS FOR HAY.

If cut at the right stage of growth and properly handled, cowpeas make excellent hay of high feeding value. This hay is as valuable as that from other leguminous crops and is greatly relished by all farm animals. Throughout the Southern States cowpea hay has been extensively used and is the main dependence for hay on the plantations. Well-cured cowpea hay has proved satisfactory for work stock and for beef or milk production and has given good results when fed to poultry, hogs, and sheep. Cowpea hay is said to be better suited for feeding to cows than to horses. Partly on this account and partly because of the difficulty often experienced in properly curing the large growth of succulent vines and its coarseness and unevenness in quality, cowpea hay has but little standing in the city markets. When it becomes generally recognized that cowpea hay is a source of protein which can be raised on the farm, the quantity of high-priced concentrated feeds purchased for young animals or dairy cows will be very materially reduced.

TIME AND METHOD OF CUTTING.

As a rule cowpeas should not be cut for hay before the pods begin to turn yellow. The best quality is produced and the hay cures most readily if the vines are cut when most of the pods are full grown and a considerable number of them are mature. At that stage of growth none of the best hay varieties will have dropped their leaves and the plants will have practically attained their full growth. If cut before this stage, the vines are watery and difficult to cure, while if left too late before cutting there will be an unnecessary loss of leaves in handling and the stems will be tough and woody.

Under favorable conditions cowpeas after being cut for hay will sprout again from the base. Considerable pasturage or even a second crop of hay or seed is sometimes produced, especially in the Gulf coast region, if good moisture conditions follow the first cutting. Ordinarily, however, but a single cutting can be obtained.

The ordinary mowing machine (fig. 6) is the most practical machine for cutting cowpeas for hay. If an erect variety is grown, the entire plant can readily be saved. When grown on a small scale or between the rows of corn, cowpea hay is sometimes harvested by pulling the vines by hand and throwing them into small cocks to

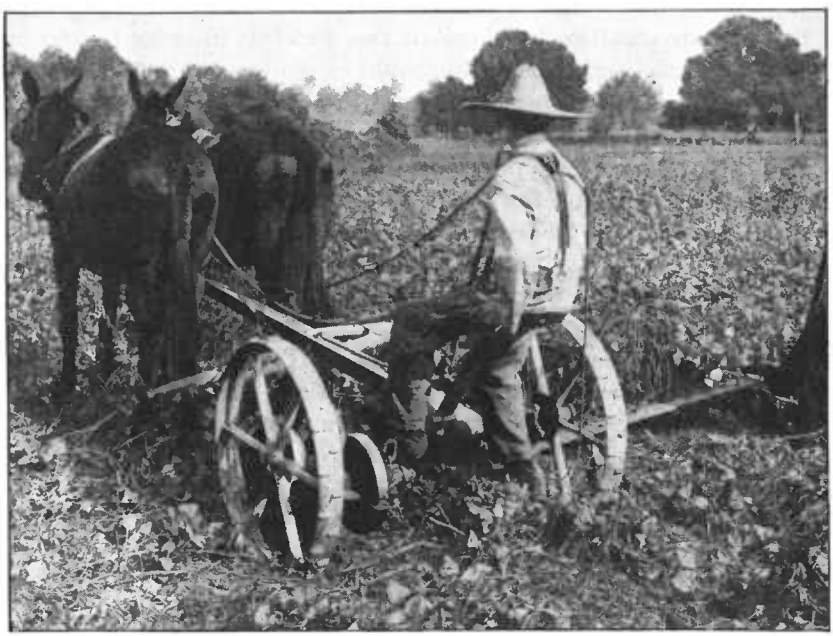

FIG. 6.—The mowing machine is the most practical implement in use for harvesting cowpea hay.

remain until cured. Scythes are also sometimes used in harvesting small areas.

CURING COWPEA HAY.

Cowpea hay is somewhat difficult to cure if not properly handled, but with attention as to stage of growth and weather conditions little more trouble will be experienced in obtaining well-cured cowpea hay than red-clover or alfalfa hay. Numerous methods of curing are employed in various sections of the cowpea region, many of which are to be recommended.

The cutting should begin as soon as the dew is off and the indications are for favorable haymaking weather. The vines should be left in the swath until well wilted on top, but not until the leaves are

dry and brittle. If the growth is very heavy the hay tedder should immediately follow the mower, so as to insure uniform drying conditions. The hay tedder may be also used to good advantage on the vines in the swath when the wilted stage of curing arrives, as it allows them to dry out more uniformly. The vines should then be raked into small windrows and left for one or two days. The tedder is also valuable for opening the windrows a half day or a day before cocking, or an ordinary rake can be used for turning the windrows over. The tedder should never be used except in the morning when the vines are damp; otherwise, too many leaves would be lost. After one or two days in the windrow, the hay should be thrown into small cocks of one or two forkfuls in order to permit circulation of the air. The cocks should be made as high and as narrow as possible and still permit them to stand well, and should be left until the vines are well cured, or from two to six days, depending on the conditions which have prevailed during the curing period. Then they should be opened a few hours before hauling or hauled without opening, according to the condition of the hay. A good rule to follow is that pea-vine hay is ready for stacking or putting in the barn when it is not possible to wring moisture out of the stems by twisting a handful with considerable force. Cowpea hay should be cured with as little exposure to the sun as possible. Too long exposure will cause the loss of the leaves, the most nutritious part of the plant.

If wet weather sets in directly after mowing, it is not advisable to handle the vines at all until after the rain. If the vines are fairly mature before cutting, a wet spell during haymaking, unless prolonged, is not of serious consequence. If, however, the vines are immature when cut, great difficulty is always experienced in unfavorable weather in curing the hay.

Many special devices are used more or less in curing cowpea hay. The most common of these is a pole, usually with crosspieces nailed at right angles, around which the vines are placed. Triangular frames (fig. 7), from 2 to 3 or more feet high, built of poles with crosspieces to hold them together, are used to some extent in the same manner. The object of these devices is to keep the vines from becoming too tightly packed and to have an air space in the center of the cock. These devices give excellent results in curing cowpeas, but, on account of the increased cost and labor involved, are not in general use.

Another method successfully practiced in some localities is that of placing the vines on poles or frames as soon as cut. The vines will form a good surface to shed water and should be left to stand two or three weeks, or until ready to stack.

The use of salt has been recommended by many successful growers. Although not essential, undoubtedly the hay is improved in palata-

bility, and it may, in the case of hay not entirely cured, assist in preventing fermentation. About 8 quarts of salt are used to 1 ton of hay.

FEEDING VALUE OF THE HAY.

The feeding value of cowpea hay has long been recognized throughout the Southern States, it having been used extensively for all kinds of stock. Well-cured cowpea hay is fully as valuable a feed, pound for pound, as red-clover hay, and its value nearly equals that of alfalfa hay or wheat bran. It has given satisfactory results when fed alone to work stock and has been used successfully as a maintenance ration for horses, mules, cattle, and sheep, and even for hogs and poultry.

FIG. 7.—Cowpeas being cured on frames for hay.

The chief value of cowpea hay lies in its high percentage of digestible protein, which has been verified by numerous feeding tests. Table VI shows comparative analyses of important hay crops.

TABLE VI.—*Analyses of cowpea hay and other important hay crops.*[1]

Kind of hay.	Constituents (per cent).					
	Moisture.	Protein.	Fat.	Nitrogen-free extract.	Ash.	Fiber.
Cowpea	10.4	16.1	3.2	40.3	10.2	19.8
Soy bean	8.4	15.9	3.9	38.8	8.9	24.1
Alfalfa	8.7	15.9	2.7	36.8	8.8	27.1
Timothy	13.2	7.1	2.8	43.3	5.4	28.2
Red clover	12.9	13.6	3.4	39.1	6.9	24.1

[1] Average analyses, as reported by G. L. Bidwell, of the Bureau of Chemistry.

The Missouri Agricultural Experiment Station,[5] in comparing cowpea hay with timothy in wintering yearling steers, found that

[5] Grantham, A. E. Cowpeas. Mo. Agr. Exp. Sta. Bul. 73, 60 p., illus. 1906.

when fed with corn the substitution of cowpea hay for timothy hay more than doubled the gains. In another feeding test at the same station, comparing cowpea hay with clover hay and timothy hay for feeding steers, the steers made nearly 50 per cent better gain with cowpea hay than with timothy, and it was found that cowpea hay and red-clover hay had nearly the same feeding value. In a test at the North Carolina Agricultural Experiment Station [6] the rations fed for three months to two high-grade Percheron mares, used as a team and receiving the same care and shelter, differed only in the use of 10 pounds of cowpea hay for the one and the same quantity of wheat bran for the other. The horse fed on bran held its own in weight, while the one fed on cowpea hay gained a little.

The Tennessee Agricultural Experiment Station [7] reports that in the production of milk and butter 1¼ pounds of chopped cowpea hay is equivalent to 1 pound of wheat bran and 3 pounds of chopped cowpea hay to 1 pound of cottonseed meal. In beef production, the same station [8] found that 6 to 10 pounds of cowpea hay could be substituted for 3 to 5 pounds of cottonseed meal. At the Alabama Agricultural Experiment Station,[9] in feeding experiments with milk cows, results show that cowpea hay increased the yield of butter 11 per cent as compared with wheat bran, although more cowpea hay was consumed. The tests indicate that cowpea hay can be substituted for a part of the bran ration with satisfactory results. The Oklahoma Agricultural Experiment Station,[10] in feeding experiments with sheep, used four lots of 10 lambs each, the feeding period covering 20 weeks. The rations fed were as follows: (1) Alfalfa and cowpea hay, with corn meal; (2) corn stover and alfalfa hay, with corn meal and cottonseed meal, 3 to 1; and (3) prairie hay, with the last-mentioned grain mixture. The total gains for each lot ranged from 393 pounds on the prairie-hay ration to 521 pounds on the cowpea hay and corn-meal ration. Gain was most cheaply made on the cowpea-hay ration, and most expensively on the prairie-hay ration. In a continuation of previous work the West Virginia Agricultural Experiment Station [11] reports results of three tests with lambs, comparing cowpea hay with mixed timothy and clover hay, with and without shelled corn. The lambs receiving cowpea hay were fed each year at a profit,

[6] Burkett, C. W. Feeding farm horses and mules. N. C. Agr. Exp. Sta. Bul. 189, p. 99–127. 1903.

[7] Soule, A. M., and Barnes, S. E. The relative value of protein in cottonseed meal, cowpea hay, and wheat bran. Tenn. Agr. Exp. Sta. Bul., v. 15, no. 4, p. 143–163, illus. 1902.

[8] Soule, A. M., and Fain, J. R. Feeding native steers. Tenn. Agr. Exp. Sta. Bul., v. 15, no. 3, p. 111–140, illus. 1902.

[9] Duggar, J. F. Vetch, cowpeas, and soy bean hay as substitutes for wheat bran. Ala. Agr. Exp. Sta. Bul. 123, p. 51–72. 1903.

[10] McDonald, W. T., and Malone, J. S. Sheep feeding. Okla. Agr. Exp. Sta. Bul. 78, p. 57–64. 1908.

[11] Stewart, J. H., and Atwood, Horace. Lamb-feeding experiments. *In* W. Va. Agr. Exp. Sta. Bul. 90, p. 217–222. 1903.

while those receiving the mixed hay were profitable only in one instance.

As a winter feed for turkeys, ducks, geese, and chickens, cowpea hay, chopped fine and moistened, may be substituted for clover and alfalfa hay and for green feed with good results. Chopped cowpea hay mixed with corn meal and moistened has proved quite satisfactory for brood sows, and may be used as a substitute for roots or green feed in winter.

YIELDS OF COWPEA HAY.

As with other hay plants, the yields of the cowpea will depend to a large extent upon the soil, culture, weather conditions, and the variety. Under average conditions, the cowpea compares quite favorably in yield with other crops commonly grown for hay, while it ranks very high in yield of feeding value. The cowpea will yield from 1 to 2 tons of hay to the acre, and frequently, under very favorable conditions, much larger yields are secured. Yields of hay of important varieties of cowpeas at different experiment stations are shown in Table VII.

TABLE VII.—*Yields of hay obtained from important varieties of cowpeas at different agricultural experiment stations.*

Variety.	Average yields per acre (tons).													
	Alabama.	Arizona.	Arkansas.	Georgia.	Indiana.	Kansas.	Mississippi.	Missouri.	North Carolina.	Oklahoma.	South Carolina.	Texas.	Virginia.[1]	Florida.
Black	1.12	.....	2.03	0.81	1.76	2.23	2.27	1.74	1.32	1.56	0.81	.....	.....	.....
Brabham	.....	.....	.....	1.12	.....	.....	1.80	.....	1.29	2.20	1.12	1.75	1.89	1.26
Clay	1.42	0.56	2.88	.60	1.93	1.94	2.27	2.11	.97	1.36	.....	.....	.....	.....
Early Buff	.....	.77	.....	.....	.....	.....	.....	.....	.....	.....	.....	.78	1.48	.....
Early Red	.....	1.56	.....	.....	.....	.....	.....	.....	1.31	.....	.....	.....	1.54	.....
Extra Early Blackeye	.71	.....	1.06	.....	.....	2.17	.....	1.56	1.28	.....	.....	.....	.71	.....
Groit	1.23	.....	.....	.....	.....	.....	2.04	2.08	1.47	1.49	.....	1.38	1.90	.48
Iron	1.55	.....	.....	1.03	1.97	.....	1.98	1.47	1.35	1.66	1.08	.93	1.88	1.01
Large Blackeye	.....	.....	.....	.98	.....	.....	1.63	.....	1.25	.....	.98	.....	.....	.....
Michigan Favorite	.....	.....	.....	.....	1.68	2.10	.....	1.63	.....	.....	.....	.....	.....	.....
Monetta	.....	2.44	.....	.....	.....	.....	.....	.....	1.53	.....	.....	1.60	1.84	.....
New Era	1.15	.....	.65	.45	1.57	2.14	1.77	1.76	1.14	1.11	1.15	.....	1.60	.53
Red Ripper	1.86	.....	1.73	.93	.....	.....	2.21	1.88	1.07	1.70	1.86	1.38	.....	.66
Taylor	.....	.64	1.86	.70	.....	2.47	2.17	.....	1.26	1.74	.....	1.10	1.81	.....
Unknown	1.57	.....	2.46	.66	.....	.....	2.33	.....	1.88	2.14	1.55	.....	.....	1.03
Whippoorwill	1.36	.....	.91	.86	1.55	2.63	1.92	1.81	1.41	2.15	.86	.69	1.83	.92

[1] Arlington Experiment Farm.

COWPEAS FOR PASTURE.

The utilization of the cowpea as a strictly pasture plant is not considered the best farm practice, but under certain conditions it is advisable and quite profitable. The cowpea furnishes a pasture crop during a period of the year when such forage can be used to the best

advantage. The small amount of work and the small cash outlay always associated with the grazing of stock commends the practice to the average farmer, and scarcity of labor often makes it necessary to pasture a crop whenever possible. Another advantage in pasturing cowpeas is that not only is the soil benefited by the growing of the cowpea but the waste vines and animal droppings are also left on the land. The soil, after cowpeas have been pastured, is in an excellent condition of productivity for the fall sowing of wheat.

The best time for turning the stock on cowpeas is when the crop has reached the stage of maturity considered best for hay—that is, when the first pods have matured. This practice, however, is not generally followed, as it is usual to gather at least a part of the seed. When cowpeas are grown in corn the grazing is deferred until the corn has been gathered. Cattle are usually turned on earlier than hogs or sheep, the hogs being pastured on the ripe seed. If stock are turned on when the plants have not attained full size, there is more waste from trampling. As with most green-pasture crops, there is danger of bloat when sheep or cattle are first turned on cowpeas, especially in wet weather. The danger from bloat, however, is far less than with alfalfa, and decreases as the cowpeas become more mature. If the seeds are sufficiently mature, frost will not greatly lessen the pasture value of the vines.

Practical experience shows that good results are obtained by pasturing cowpeas with any kind of live stock. The most common practice is to hog them down. For young hogs, cowpeas are an excellent feed, and but little grain is required to bring them to market weight. Usually hogs will feed on the mature pods first and leave the vines and leaves, especially when dry. After pasturing hogs on a field for some time, cattle or sheep may be used profitably to pasture off the leaves and vines which the hogs leave. Sheep may be used on cowpeas in the same way as hogs. When sown in corn, the stover blades and cowpea seed make a fine ration for fattening fall lambs and wethers. Dairy cows show the effect of such pasturage in a much-increased flow of milk.

At the Arkansas Agricultural Experiment Station[12] steers were fattened on cowpea pasture and cottonseed meal, making an average gain of 2 pounds a day for 90 days. As long as the cowpea vines were green and considerable seed was available, very little cottonseed meal was eaten. The cost of each pound of gain was only 2 cents for the cottonseed meal, thus showing the high value of the cowpea pasturage. The Oklahoma Agricultural Experiment Station[13] reports that cowpeas planted in July furnished two grazing

[12] Bennet, R. L. An experiment in grazing a corn and cowpea field with steers. *In* Ark. Agr. Exp. Sta. Bul. 58, pp. 97–100. 1899.

[13] Burtis, F. C. Crop and forage notes. Okla. Agr. Exp. Sta. Bul. 48, 11 p. 1900.

periods for milk cows before frost and that the flow of milk was noticeably increased.

In a feeding trial at the Alabama Agricultural Experiment Station[14] it was found that pigs fed on corn alone gained 0.36 pound daily, while hogs on cowpea pasture and corn gained 0.97 pound daily, consuming 36 per cent less corn for each pound gained. The same station[15] conducted a feeding experiment with pasturage for dairy cows, using an upland cornfield from which the ears had been removed and in which cowpeas had been drilled between the rows. The field was first pastured by three milk cows and later by three dry cows. The milk cows in the meantime received 3 pounds of cottonseed meal daily. On this pasturage the yield of milk was 15.8 per cent greater and the yield of butter 9.5 per cent greater than when the cows with the same grain feed ran on a good pasture of Bermuda grass, carpet grass, and lespedeza. In addition to the gain of milk and butter, the milk cows gained a total of 85 pounds during the 19 days and the dry cows a total of 53 pounds in 9 days.

COWPEAS FOR ENSILAGE.

The cowpea alone has not proved very successful as a silage crop. Most legumes give less satisfactory results when used alone for silage than when mixed with some other crop, such as corn or sorghum.

In addition to a high protein content the green vines of the cowpea contain a large proportion of water, producing a watery silage that keeps poorly and is not well relished by stock. Moreover, the vines form a tangled mass, which is difficult to cut, and without cutting the vines do not pack well, allow the air to enter, and cause the silage to mold.

The best silage is obtained when cowpeas are grown or mixed with corn or sorghum. Various methods are employed in growing and working in the silo the crops used in the mixed silage. The best results have been secured by planting cowpeas at the same time with the corn, using a cowpea attachment to the corn planter. Another common practice is to plant the seed alongside the corn rows at the second cultivation and sometimes at the last cultivation of the corn. In some sections of the South corn or sorghum and cowpeas are often sown in alternate rows.

For silage, cowpeas should be cut when the pods first begin to turn yellow. In many sections alternate rows of cowpeas and corn are put in the silo, but the most common method, perhaps, is one load

[14] Duggar, J. F. Peanuts, cowpeas, and sweet potatoes as food for pigs. Ala. Agr. Exp. Sta. Bul. 93, p. 113–134. 1898.

[15] Duggar, J. F., and Clark, R. W. Feeding experiments with dairy cows. Ala. Agr. Exp. Sta. Bul. 114, p. 53–80. 1901.

of cowpeas to two or three loads of corn. This mixture is easily handled, packs quite satisfactorily, keeps well, and makes a superior quality of palatable silage. Although the vines may be put in the silo without cutting, they will pack much closer if run through a silage cutter. Much care should be taken to see that the silage is well distributed and well packed.

When combined with either corn or sorghum, mixed silage has a greater feeding value than either corn or sorghum silage alone. As cowpeas are relatively high in protein, the mixed silage furnishes a better balanced ration. In testing the value of cowpea silage as a substitute for bran with milk cows, the Delaware Agricultural Experiment Station [16] found that, considered on the basis of milk and butter, the balance was in favor of cowpeas. The same station, in comparing cowpea silage for milk cows, found that 40 pounds of cowpea silage was very much superior to its own weight of corn silage, plus 1½ pounds of cottonseed meal. Table VIII compares the average composition of crops most generally utilized for ensilage.

TABLE VIII.—*Average composition of various silage crops.*[1]

Crop.	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
Corn	79.1	1.4	1.7	6.0	11.0	0.8
Sorghum	76.1	1.1	.8	6.4	15.3	.3
Cowpea and sorghum	68.4	1.9	2.2	8.5	18.3	.7
Cowpea	79.3	2.9	2.7	6.0	7.6	1.5
Soy bean	74.2	2.8	4.1	9.7	6.9	2.2

[1] Henry, W. A., and Morrison, F. B. Feeds and feeding. Ed. 17, x, 691 p. Madison, Wis., 1917.

COWPEAS FOR SOILING.

Cowpeas can be utilized to good advantage as a soiling crop. With its high percentage of protein it is an excellent supplement to less nitrogenous crops, such as corn, sorghum, and millet. The wide variation in the maturity of the varieties makes it possible to have an abundance of green forage throughout the greater part of the summer and fall.

COWPEAS FOR SOIL IMPROVEMENT.

The cowpea has been used as a restorative crop more than any other leguminous crop, especially throughout the Southern States. It is so easily grown and has such a marked effect on the succeeding crops that its use should be greatly increased. Aside from increasing the productiveness of the soil, the cowpea also improves its general

[16] [Cowpea silage vs. bran for milch cows.] *In* Del. Agr. Exp. Sta. Bul. 26, p. 10–11. 1895.

physical condition, making heavy clay soils more open and sandy soils more compact. The cowpea has the distinct advantage of making a good growth on soils that will not produce profitable yields of other legumes or cereals. It is an excellent green-manure crop for vineyards and orchards.

Except on the poorer soils, results indicate that it is decidedly more profitable to utilize the cowpea as hay or pasture and then plow under the stubble than it is to plow under the entire crop. About 85 per cent of the fertilizing and soil-improving value of the cowpea is contained in the hay and about 15 per cent in the roots and stubble. Feeding experiments indicate that much of the fertilizing value of feeds is recovered in the manure. It is therefore possible to obtain the feeding value of the cowpea as hay or pasture and in returning

FIG. 8.—Plowing under cowpeas for green manuring.

the manure to the soil to save a large part of the fertilizing value, provided the manure is well handled. When the whole crop is plowed under, a more beneficial and lasting effect is obtained, but this advantage is not great enough to equal the feeding value of the cowpea.

Light or sandy soils that have been cropped for a long time and need humus receive greater benefit from plowing under the whole crop. (Fig. 8.) When, therefore, the improvement of the land is the sole object, the entire crop should be plowed under to obtain the greatest value. In utilizing the entire crop for soil improvement, it is best to plow it under when green before being killed by frost. The green plants decay more readily and are superior to dry plants in their fertilizing effect.

The results of analyses made by the North Carolina Agricultural Experiment Station[17] show that 1 ton of cowpea hay contains 47 pounds of nitrogen, 10 pounds of phosphoric acid, and 29 pounds of potash. Table IX gives the fertilizing materials in 100 pounds of dry substance of legumes commonly utilized for soil-improving purposes.

TABLE IX.—*Fertilizing constituents in 100 pounds of dry substance of the tops and roots of important legumes.*

Plant and part.	Nitrogen.	Phosphoric acid.	Potash.	Plant and part.	Nitrogen.	Phosphoric acid.	Potash.
Red clover:				Cowpea:			
Tops.....pounds..	2.35	0.58	2.14	Tops.....pounds..	1.96	0.51	1.93
Roots.....do....	2.74	.84	.82	Roots.....do....	1.18	.55	.93
Alfalfa:				Soy bean:			
Tops.....do....	2.30	.54	1.52	Tops.....do....	2.18	.61	1.68
Roots.....do....	2.04	.43	.48	Roots.....do....	1.05	.34	.67
Crimson clover:				Velvet bean.....do....	2.51	.53	3.84
Tops.....do....	2.13	.62	1.35	Common vetch:			
Roots.....do....	1.50	.47	1.02	Tops.....do....	2.99	.71	2.68
				Roots.....do....	2.19	.79	1.18

Numerous experiments with the cowpea for soil-improving purposes demonstrate its beneficial effect upon succeeding crops, as shown by the increased yields obtained of corn, cotton, sorghum, and small grains. At the Alabama Agricultural Experiment Station[18] the increased yield of the following crops, showing the benefits obtained by plowing under the cowpea vines rather than taking the crop off for hay, was as follows: Corn, 49 per cent; sorghum, 9 per cent; cotton, 40 per cent. At the Missouri Agricultural Experiment Station[19] an increase in yield of 63 per cent with oats and 49 per cent with wheat following cowpeas as a catch crop was secured. The Arkansas Agricultural Experiment Station,[20] in tests covering four years with wheat, reports an average increase in yield of 25 per cent from plowing under cowpea stubble in the fall, 39 per cent from plowing under cowpea vines, and 42 per cent when cowpeas were grown each year as a catch crop between the wheat crops, only the stubble of the peas being turned under. At the same station[21] a crop of cowpeas on light sandy soil grown after harvesting rye and potatoes increased the following wheat crop 30 per cent. Wheat grown continuously on the same land for three years and each crop preceded by a crop of cowpeas

[17] Kilgore, B. W., Williams, C. B., MacNider, G. M., and Meacham, F. T. The culture of the cowpea. Bul. N. C. Dept. Agr., v. 31, no. 6, p. 70, illus. 1910.

[18] Duggar, J. F. The cowpea and the velvet bean as fertilizers. Ala. Agr. Exp. Sta. Bul. 120, p. 121–179, 3 figs. 1902.

[19] Grantham, A. E. Cowpeas. Mo. Agr. Exp. Sta. Bul. 73, 60 p., illus. 1906.

[20] Newman, C. L. Cowpeas: Fertilizing value. Ark. Agr. Exp. Sta. Bul. 77, p. 12–22. 1903.

[21] Newman, C. L. Wheat experiments. Ark. Agr. Exp. Sta. Bul. 62, p. 17–34. 1900.

gave an increased yield of 46.7 per cent, as compared with breaking the wheat stubble and not sowing cowpeas. The Georgia Agricultural Experiment Station[22] conducted an experiment with cowpeas followed by cotton in order to determine whether it would be more profitable to turn under the vines as green manure, to harvest as hay, or to pick the pods and plow under the vines. The results obtained indicated that the effects upon the subsequent crops of cotton were almost identical, being, however, slightly in favor of turning under the vines green. When, however, the value of the seed and the hay is taken into consideration, the experiments show that it is much more profitable to save the cowpeas as hay or as seed, and that either of these methods is more economical than the practice of turning under the entire crop.

[22] Redding, R. J. Green manuring with cowpeas. *In* Ga. Agr. Exp. Sta. Bul. 27, p. 207–209. 1894.

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